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NOTES ON SOUTH AMERICAN MAMMALIA.—No. 1. *SCIURILLUS*

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The receipt of more than thirty specimens of this rare genus of squirrels from native field collectors working in Brazil for the American Museum has prompted us to go over the rather scanty literature and survey the status of *Sciurillus*.

Miss Barbara Lawrence, of the Museum of Comparative Zoölogy, Cambridge, Mass., upon learning that we have had the present paper in hand for some time, has generously turned over to us notes prepared by her on the taxonomy of the forms of *Sciurillus*, which she based upon three specimens from the Tapajoz region and three from French Guiana (loaned to her by the Field Museum). We are further indebted to Miss Lawrence for informing us of the presence of these three specimens of true *pusillus* from French Guiana in the collection of the Field Museum. And to Dr. W. H. Osgood, who has loaned us the three animals just alluded to, we wish to express our thanks.

A South American pygmy squirrel was definitely described by Buffon (1789)[1] under the name "le petit guerlinguet," and by Desmarest (1817) it was given the technical specific name *pusillus* and placed in the blanket genus *Sciurus*. No further constructive mention of the animal appeared for half a century until Gray (1867) redescribed *pusillus* (he had a specimen in the British Museum), described *Macroxus kuhlii* (based upon a specimen purchased by the British Museum with the Castelnau collection), and transferred *pusillus* Desmarest to *Macroxus*. A decade later Allen (1877) concluded, not solely from the literature,[2] that *pusillus* and *kuhlii* were not only synonymous with one another but merely juveniles of *aestuans*.

The first hint that these tiny squirrels ought to be generically separated from *Sciurus* appeared when Alston (1878) drew attention to

[1] In Buffon (1776 and 1777) there appears a vague allusion, possibly to this squirrel: ". . . says that there is in Guiana only a single species of squirrel, which lives in the woods, that its fur is reddish, and that it is no larger than the rat of Europe, that it lives on seeds of Maripa . . . , that it produces its young, two in number, in holes in trees. . . . " In 1789, however, Buffon distinguished and described the "grand guerlinguet" and the "petit guerlinguet," both from Guiana. The latter became *Sciurillus pusillus*. We feel that the original description should be taken as from 1789.

[2] "I have before me another, from Brazil, which I believe to be only a very young example of *S. aestuans*, although in size and coloration it agrees perfectly with the descriptions of *S. pusillus*." [Allen, 1877, pp. 759–760.]

the additional premolars of *pusillus* material from Guiana and of *kuhlii* (which he held to be a synonym of *pusillus*). He stated then that he had failed to find the type of *pusillus* in the Paris Museum. Allen (1878), accepting Alston's views, promptly admitted the distinctness of these squirrels from *aestuans*.

Another quarter of a century passed before Thomas (1914*a*, *b* and *c*) was induced by the receipt of new material from British Guiana to reëxamine the British Museum specimens. A few years before (1909) he had worked out the genera of African squirrels and this fact doubtless led him to compare the skulls of *pusillus* and *kuhlii* with those of *Nannosciurus* of Malaysia and *Myosciurus* of West Africa. As a result he set up the new genus *Sciurillus*, with type *pusillus*, and declared it most nearly allied to the above two genera. Writing under the heading of *Microsciurus* a few months earlier, Allen (1914) had apparently entertained no suspicion of the above facts, but without having seen either, had separated *pusillus* and *kuhlii* widely. The next year however Thomas, basing his conclusions on the divergent structure of the os priapi of *Myosciurus* and *Nannosciurus*, judged his own subfamily Nannosciurinae to be artificial. Pocock (1923) also denied relationships of *Myosciurus* and *Nannosciurus*, considering their common characters the result of convergence.

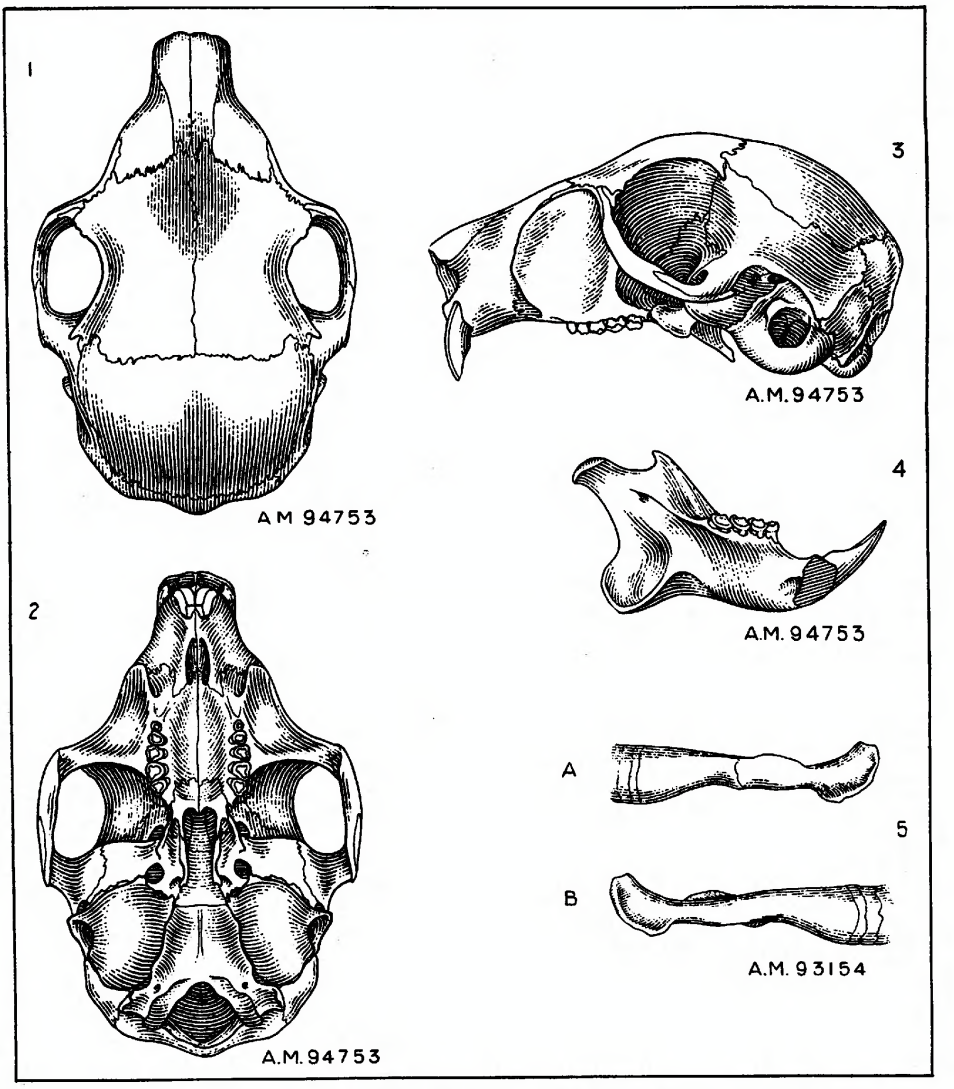
Of great geographical interest was Thomas's (1928) receipt of two specimens from Pebas, on the upper Amazon in eastern Peru, which he mentioned under the name *pusillus*. In consequence of that discovery, he suggested that the type of *kuhlii*, supposed to have been collected by Castelnau, might well have been obtained at Pebas.

By recent writers on the anatomy and taxonomy of the Sciuridae, Pocock (1922, 1923), Weber (1928), Frechkop (1932), *Sciurillus* seems to have been wholly ignored. This is probably due more to its great scarcity in collections than to the assumption that it is synonymous with *Microsciurus*. Pinto (1931) includes *Sciurillus* in his key to genera, but fails to record *pusillus* as a member of the Brazilian squirrel fauna.

From the foregoing general résumé of the systematic standing of *Sciurillus*, one is left with the impression that Thomas's (1914) paper pointing out some of the generic characters of the genus was based upon defective evidence. The difference between the bacula of *Myosciurus* and *Nannosciurus* (and, by implication, of *Sciurillus* whose baculum has never, so far as we know, before been examined),[1] this single character

[1]We have had the baculum of No. 93154 extracted and cleaned and present herewith a line drawing of it (Fig. 5). It appears to be of relatively simple structure, in no way resembling illustrations of those of *Nannosciurus* (Pocock, 1923, p. 223, text-fig. 22, H, I, K). Rather it seems nearest to that of *Sciurus niger* (p. 215, text-fig. 19, A, B). This fact, if reliance is to be placed upon differences in form of the baculum, tends to separate *Sciurillus* from *Nannosciurus*.

difference, we are urged to believe carries far greater weight than the not inconsiderable number of quite remarkable resemblances which we list beyond, briefly dismissed by Pocock (1923, p. 212) as "convergent



Figs. 1 to 5. Views of skull and of os priapi of *Sciurillus pusillus*.

1, dorsal view; 2, ventral view; 3, lateral view; 4, lateral view of inner face of mandible; all four × 2; 5, os priapi, × about 7; A, seen from left side, B, seen from right side.

characters." Furthermore, considering the number of cases of discontinuous distribution which have been satisfactorily explained (for example, the tapirs and hystricomorphs), the geographical discontinuity

between Malaysia and South America offers no serious barrier to the idea of true relationship between *Sciurillus* and *Nannosciurus* (we have seen no examples of *Myosciurus*). In support of this conception of such a relationship, the following table illustrates important differences between *Nannosciurus* and *Sciurillus* (taken together) and representative species of *Sciurus*, such as *vulgaris*, *carolinensis*, and *hoffmanni*. The divergent characters of the two pygmy genera are at least in part the result of extreme shortening of the base of the skull combined with a strong arching tendency. It will be noted that in certain respects *Microsciurus* holds an intermediate position.

COMPARISON OF SKULLS OF "NANNOSCIURINE" SQUIRRELS WITH SCIURINE SQUIRRELS

Sciurillus and *Nannosciurus* (*borneanus*)	*Sciurus vulgaris*, *carolinensis*, etc.
1. Great interorbital breadth: $\frac{\text{interorbital breadth}}{\text{length of frontal}}$ approximately 1.	1. $\frac{\text{Interorbital breadth}}{\text{Length of frontal}}$ definitely less than 1.
2. Great development of pterygoid wings of alisphenoids [the "ectopterygoids" of Thomas (1914, p. 416)].	2. Slight development of same.
3. Circular form of the orbitotemporal fossa with displacement of the zygomatic process of the squamosal forward to lie below the postorbital process of the frontal.	3. Elongate-oval form of orbitotemporal fossa. No displacement forward of zygomatic process of squamosal.
4. A much greater separation of the frontal process of the premaxilla from the lacrimal by means of a broader contact between maxilla and frontal. Extrusion of greater part of lacrimal into margin of orbit.	4. Only moderate separation of lacrimal from frontal process of premaxilla by contact of frontal with maxilla. But in *Microsciurus* the condition is as in *Sciurillus*. Greater part of lacrimal withdrawn from orbit and lying between frontal and zygomatic process of maxilla.
5. Viewed from the side, the area of maxilla representing the origin of the infraorbital part of the masseter considerably exceeds the area of the lateral face of the premaxilla just anterior to it.	5. This area of portion of maxilla distinctly less than that of premaxilla anterior to it.

Sciurillus and *Nannosciurus* (*borneanus*)	*Sciurus vulgaris, carolinensis*, etc.
6. A pronounced flange or ridge crossing the orbital surface of the alisphenoid from the base of the zygomatic process of the squamosal to the origin of external pterygoid muscle. Also inflation of that part of the alisphenoid anterior to the bulla.	6. Such a ridge nearly or quite absent. No inflation of alisphenoid, just anterior to the bulla (except in *Microsciurus*, in which both characters are incipient).
7. Upper incisors strongly proödont.	7. Upper incisors normal (proödont in *Microsciurus*).
8. Coronoid process of mandible reduced in *Sciurillus*, approaching obsolesence in *Nannosciurus*.	8. Coronoid process of mandible present and normal (except *Microsciurus*).
9. Articular process of mandible attenuate, drawn backward to form a hook.	9. Articular process not so formed.

In the succeeding table we point out some of the differences between the skulls of *Sciurillus* and *Nannosciurus*. All of these differences, except numbers 3 and 5, it will at once be noted are of a smaller order of magnitude than those described in the previous table.

Sciurillus	*Nannosciurus* (*borneanus*)
1. Paroccipital processes normally developed.	1. Paroccipital processes almost obsolete.
2. A medial palatal projection backward into pterygoid fossa.	2. No such projection of palate.
3. Baculum most nearly similar to that of *Sciurus niger*.	3. Baculum hinged and hook-shaped.
4. Insertion area for internal pterygoid muscle a deeply excavated fossa.	4. Insertion area for internal pterygoid not so deeply excavated.
5. Jugal a slender element with no postorbital process, articulation with squamosal very extensive.	5. Jugal proportionally broad, with noticeable postorbital process, articulation with squamosal restricted to less than half the posterior extent of jugal.

The above facts confirm, in most respects, Thomas's original conception of the generic position of *Sciurillus*, although the case is still open

to some doubt as to the exact degree of relationship between *Sciurillus* and *Nannosciurus*.

From the distributional standpoint, *Sciurillus* is now recorded from the Guiana coastal strip; from our newly worked west Tapajoz region on the south bank of the Amazon, all the localities of which will go into a circle 200 miles in diameter; and from the Ucayali drainage basin in eastern Peru. (See map, Fig. 6.) From the standpoint of taxonomy we appear to be dealing with a monotypic genus which may or may not be susceptible of division into slightly differentiated geographical races.

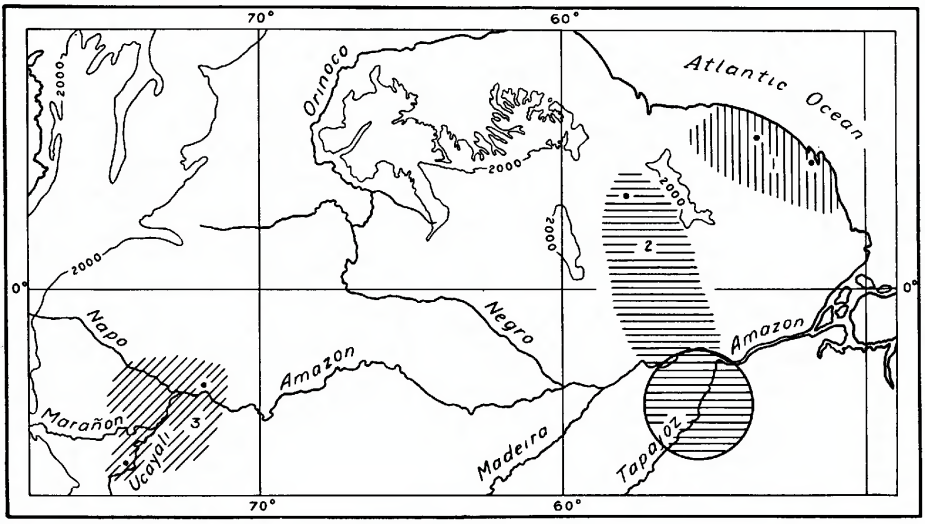


Fig. 6. Map showing the distribution of *Sciurillus*.

Dots represent single localities and the circle encloses a number of locality records of the Tapajoz area. Shaded areas mark the suggested distributions of the three subspecies of *pusillus:* 1, *S. pusillus pusillus;* 2, *S. pusillus glaucinus;* 3, *S. pusillus kuhlii.*

A discussion of this question of geographical races is pertinent in view of material now available.

Three specific or subspecific names have been applied to squirrels of the genus *Sciurillus—pusillus*, *glaucinus*, and *kuhlii*, the first two to animals from French and British Guiana, the last to those from eastern Peru. The type locality of *glaucinus* alone is definite—Great Falls of Demarara River, British Guiana. The type locality of *pusillus* may be considered restricted, according to Desmarest's (1817) suggestion, to Cayenne, French Guiana. Thomas's *glaucinus* from 400 miles west of Cayenne was separated from *pusillus* mainly on the basis of its much paler coloring, and we may infer that he had before him true *pusillus* for

comparison, from his mention of the "greyish hair brown" and "dark grey washed with fulvous" body color and the "almost ferruginous" color of the head of *pusillus*. Even he, however, makes no mention of the white postauricular patches of true *pusillus*, though he does write of them when describing *glaucinus*. This feature, also characteristic of *kuhlii*, is present (rarely slightly suppressed) in every one of our series from the Tapajoz region, as well as in what we consider to be typical *pusillus*. Neither Buffon nor Desmarest mentioned these white patches when describing the species. Gray (1867) implied that the British Museum specimen, or specimens, lacked the whitish ear patches and Alston (1878) speaks of two specimens in the British Museum from which *kuhlii* differs in having these patches. In the Field Museum specimens, which are virtually topotypes of *S. p. pusillus*, since they come from the Mana River some 80 miles west of Cayenne, the light-colored ear patches are found well-developed. We are puzzled as to the exact status of these British Museum pigmy squirrels which lack the light-colored ear patches. Specimens of *Microsciurus* should not have been confused with those of *Sciurillus* by Gray and Alston (although the former genus was not recognized at that time) and no specimens of this group have ever been collected very far east of the slopes of the Andes. Possibly later collecting will disclose a Guiana *Sciurillus* which consistently lacks these patches, but the material now at hand implies the contrary.

A character of some importance, not noted earlier than in Miss Lawrence's manuscript, is the color of the outer tips of the ears of the French Guiana squirrels, which is quite black, and the decidedly reddish shade of the head anterior to the ears. In all other material seen by us, the ears and head are colored externally nearly like the body.

Material examined by us:

French Guiana: Tamanoir, Mana River	2 ♂	Skin and skull (without lower jaws)
	1 ♀	Skin and skull
Peru: Sarayacu, Rio Ucayali	1 ♂	Skin and skull. Collected 30 March, 1927
Brazil (south bank of R. Amazon):		
Between R. Madeira and R. Tapajoz:		
Lago Andira, near Villa Bella Imperatriz	2 ♂	Skins with the bodies in alcohol. Collected September, 1930
Boca Rio Andira, near Villa Bella Imperatriz	1 ♂	Entire in alcohol
	♀	Skin, body in alcohol. Collected October, 1930

Lower Rio Tapajoz (left bank, between Boim and mouth):		
Igarapé Brabo	9♂	Skins and skulls
	7♀	Skins and skulls. Collected June, 1931
Igarapé Amorin	1♂	Skull only
	1♀	Skin and skull. Collected June, 1931
Limoal (on Igarapé Amorin)	7♂	Skins and skulls
	1♀	Skin and skull. Collected July, 1931
Limontuba (on Igarapé Amorin)	2♂	Skins and skulls
	1♂	Skin only. Collected August, 1931

Total material: 37 specimens.

In the table following this paper the few measurements that have been published in descriptions are compared with those of a representative set of specimens from our new series and those of the three *p. pusillus* from French Guiana. To facilitate this comparison we have adopted the same set of cranial measurements as were used by Thomas in his description of *glaucinus*. The study is valuable only for its demonstration of the great structural uniformity of these squirrels. Even sexual deviations are at a minimum. Nor by direct comparison of the skulls at hand have we succeeded in finding any but inconstant or individual differences. Length of pelage is of very doubtful value,[1] since nothing is known about the molt of pygmy squirrels and, in any case, difference in the length of the fur, even when correlated with distribution, is likely to be merely a somatic phenomenon.

Only color differences remain for consideration. On the basis of their black-tipped ears and reddish heads the French Guiana material can at once be separated from the remainder. The male and female recorded by Thomas (1928) from Pebas were not described. The long series of material from the Tapajoz agrees closely with Thomas's description (1914*c*) of *glaucinus*. And finally, our individual (a male) from Sarayacu, 300 miles southwest of Pebas, is somewhat more saturate than our Tapajoz material, having the belly even more cinnamon than the hazel of *p. pusillus* and the back slightly darker. Its head is similar in color to the body, being only slightly tinged with rufous about the muzzle. The hairs of the tails in Guiana and Tapajoz material are much less full than are those of our Sarayacu animal, the former being some 14 mm. in length, taken along the side of the tail, and the latter 17 mm.

In conjecturing the identity of *kuhlii*, we may compare Gray's description with our known material as follows: "fur soft, nearly uniform

[1]Except perhaps that of the tail. See beyond.

olive, slightly washed with yellowish." Compare with "neutral gray" of *glaucinus*. Our Tapajoz animals may be placed in color between drab and hair brown, but with a slightly yellowish wash, and the Sarayacu animal is near hair brown with a deeper overwash near honey yellow or tawny olive. "Chin and under sides rather paler and yellower" (Gray) may be contrasted with "pale gray washed with light buffy" (*glaucinus*) and with chaetura drab washed with hazel, slightly deeper for the Sarayacu animal than for the Tapajoz series. "A white spot above the base of each ear" (common to all). "Tail blackish, whitish washed; hairs yellow, with a broad subterminal band and white tip" (Gray). Of *glaucinus* Thomas wrote: "Tail hairs tipped with whitish, a number of hairs in the terminal pencil black, a line along the center below also black." In all material before us, the hairs of the tail are made up of three kinds: whitish hairs with black tips, black hairs with whitish tips, and black hairs with a whitish subterminal band, the tip again becoming black. Various proportions of these three can easily account for differences in descriptions. We find little difference between the tails of *p. pusillus* of French Guiana and the animals from the Tapajoz, except a slight deepening of the yellow-white tone in the former. The pencil hairs of the Tapajoz form reach 23 mm. in length, of true *pusillus* 33 mm., and of our Sarayacu specimen whose tail is unusually short, possibly deformed, over 60 mm. in length. This last may also be due to injury and consequently is without value for purposes of taxonomy.

The "olive" back (of Gray) fits either the French Guiana or the Peruvian animal more closely than either typical *glaucinus* or the Tapajoz form. "Rather paler and yellower" (than the dorsum) agrees only imperfectly with any of the squirrels before us. "Hairs (of the tail) yellow," etc., harmonizes rather well with our Sarayacu specimen, at least in regard to the hairs of the proximal half of the tail. On the basis of the above comparison, then, we would refer our specimen from Peru to *kuhlii*, and our long series from the Rio Tapajoz we incline to place with *glaucinus*, on account of the generally paler and grayer dorsal coloration, for although we have had no opportunity to have them compared with typical material, we can find no point of divergence from the description of *glaucinus*, except that we would not describe the white of the ears and ear patches as "snowy."

As for the source of the type of *kuhlii*, it was marked "Brazil (Castelnau)" by Gray. Thomas (1914*b* and *c*) implied that it had been mixed with Castelnau material by the dealer Parzudaki and really came from Guiana. Years later (1928), after receiving material from Pebas,

he reversed his former opinion and suggested that Castelnau might after all have taken the type in the upper Amazon region.[1]

Thus the type locality of *kuhlii* remains doubtful. But in view of the fact that the type of *kuhlii* seems to have been a fairly dark animal with the tail hairs yellow at the base, and that it MAY have been collected by Castelnau, we incline, in the absence of evidence to the contrary, to restrict its type locality to Pebas, referring our squirrel from Sarayacu to *kuhlii*. And tentatively we leave *Sciurus pusillus* as three geographical races (all with light-colored ear patches):

Sciurillus pusillus	Cayenne	A brown squirrel with reddish head and the outer surface of the ears black
Sciurillus pusillus	Eastern Peru	A brown squirrel with ears colored as head. Under parts washed with deep hazel. Tail hairs relatively long (at sides of tail 19 mm.)
Sciurillus pusillus glaucinus	Demarara and the Tapajoz region	A gray-brown squirrel with ears colored as head. Under parts washed with light hazel. Tail hairs relatively short (at sides of tail 15 mm.)

BREEDING HABITS.—The following notes on breeding habits of the Tapajoz form, taken from field labels, indicate that June is at least one of the important breeding months and that normally two young are born at a time. Four females from Igarapé Brabo were marked as having two embryos; one female from Igarapé Amorin was shown to have one embryo. All of these specimens were taken in June. A female from Limoal in July and another from Boca de Andira in October were not labeled as having embryos. A single female from Igarapé Brabo collected in June was marked "6 mammae with milk." On the backs of the labels the local name is shown as "Cuatipuruzinho."

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[1] In Castelnau's 'Expedition dans les parties centrales de l'Amerique du Sud . . . Histoire du Voyage,' IV, Chap. LIV, Chap. LV, 1851, he made frequent allusions to animals brought in by Indians at Sarayacu, Nauta, and Pebas. So, even though he nowhere mentioned receiving squirrels of any kind, he had ample opportunity to do so.

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Table of Measurements

	Sex	Locality	Head and Body	Tail	Hind Foot	Greatest Length of Skull	Condylo-incisive Length	Zygomatic Breadth	Nasals (outer edge)	Interorbital Breadth	Breadth Brain Case	Palatilar Length	Upper Molar Series (excl. P^3)	Remarks
Males														
Type description of *pusillus*	ad. ♂	Cayenne	108	76	....	.....	.....	....	....	....	....	....	....	Measurements transposed from inches and lines of Buffon. (Desmarest wrote "scarcely 3 inches long").
F.M.21790 *p. pusillus*	ad. ♂	Fr. Guiana	102	98	24	26.8	24.5	20.2	7.6	11.7	14.7	10.0	3.7	Collector's skin measurements.
F.M.21788 *p. pusillus*	ad. ♂	Fr. Guiana	107	98	24	.....	.....	....	7.1	11.5	13.4	10.6	3.8	Collector's skin measurements.
Type of *kuhlii*		Pebas	...	...	26	.....	.....	....	....	....	....	....	....	No measurements of type were published by Gray, although a suggestion of the size was given by Alston (1878). The foot measurement of *kuhlii* is given by Thomas (1914, p. 575). It does not include the claws.
A.M. 76185 *kuhlii*	ad. ♂	Sarayacu	100	80	28	28	25	19.8	7.8	12.2	14.5	10.4	3.7	Measured from dry study skin.
B.M. 14.4.21.1 Type of *glaucinus*	ad. ♂	Demarara	104	113	27.7	27.5	25	20	7	12.5	15	10	3.8	Hind foot measurements given by Thomas are without claws.

A.M. 95729 *glaucinus*	ad.♂	Tapajoz	98	100	28	27.2	24.9	19.3	6.9	12.6	....	10.4	.....	External measurements of this specimen and following were taken on fresh specimens by field collector. Feet measured to include claws.
A.M. 95730 *glaucinus*	ad.♂	Tapajoz	97	98	28	27.4	25	....	7.2	12.0	14.8	10	3.7	
A.M. 95734 *glaucinus*	y.ad.♂	Tapajoz	89	111	27	.....	.....	19	7.5	10.8	....	10	3.9	In this instance the collector included the pencil of hairs at the end of tail.
A.M. 94746 *glaucinus*	ad.♂	Tapajoz	80	114	21	28	25	19.6	7.3	11.8	14.5	10.4	4.0	Foot measurement plainly in error. Approximates 26.
A.M. 94752 *glaucinus*	y.ad.♂	Tapajoz	98	100	24	26.9	24.3	18.8	6.8	11.4	13.8	11.0	3.8	
FEMALES														
F.M.21789 *p. pusillus*	ad.♀	Fr. Guiana	107	105	25	28.6	25.4	20.1	7.9	12.5	14.6	10.8	4.0	Collector's skin measurements.
A.M. 94743 *glaucinus*	ad.♀	Tapajoz	96	102	29	28	24.6	18.4	7.3	11.4	14.4	11.3	....	
A.M. 94744 *glaucinus*	ad.♀	Tapajoz	100	90	27	27.2	24	19	7	11.6	14.2	9.9	3.7	
A.M. 94748 *glaucinus*	ad.♀	Tapajoz	102	76	27	27.2	24.6	18.9	7.1	11.7	14.8	10.3	....	Tail measurement erroneous.
A.M. 94751 *glaucinus*	o.ad.♀	Tapajoz	102	56	28	28	25.3	19.8	7.7	12.1	14.5	11	3.8	Tail measurement erroneous.